

REMARKS

The specification at page 1, under “CROSS-REFERENCE TO RELATED APPLICATION” has been amended to more accurately indicate that this application is a 371 of PCT/JP2005/006520 filed March 20, 2005, claiming benefit of U.S. Provisional Application No. 60/559,429 as indicated in the Declaration and Power of Attorney filed September 26, 2006.

In response to the objection to the disclosure, the Title of the Invention has been amended as suggested by the Examiner. Withdrawal of the objection is respectfully requested.

Withdrawn method claim 9 has been amended to include all of the limitations of device claim 1. If device claim 1 is found to be allowable, Applicants respectfully request rejoinder of withdrawn method claims 9-11 pursuant to MPEP §821.04.

Review and reconsideration on the merits are requested.

Claims 1-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. 2003/0047737 A1 to Lin et al further in view of U.S. 2004/0169184 A1 to Udagawa et al.

Lin et al was cited as disclosing a light-emitting device substantially as claimed, including a stacked structure (reference nos. 10, 14, 16, 18, 20, 22, 28, 30-32 and 34, including AlGaInP active layer 20) joined through conductor layer 18 to transparent substrate 10. Acknowledging that “conductor layer 18” does not contain boron, the Examiner relied on Udagawa as disclosing a light-emitting device where conductor layer 106 is composed of a Group III-V compound semiconductor containing boron. The reason for rejection was that it would have been obvious to employ the “conductor layer” of Udagawa et al in the device of Lin et al so as to provide excellent electrical and emission characteristics.

Applicants respond as follows.

(1) Features of the Present Invention

The present invention provides a pn junction compound semiconductor light-emitting device, comprising a stacked structure (11) including a light-emitting layer of an n-type or a p-type aluminum gallium indium phosphide light-emitting layer (103) and a light-permeable substrate (106), that is, a substrate which is transparent with respect to emission wavelength, for supporting the stacked structure (11). The stacked structure (11) and the light-permeable substrate (106) are joined together. Further, the stacked structure (11) includes an n-type or a p-type conductor layer (105) on an upper cladding layer (104), the conductor layer (105) and the base plate (106) are joined together, and the conductor layer (105) is composed of a Group III-V compound semiconductor containing boron.

The thus formed light emitting device of the present invention has low resistance, allows device operation current to easily flow, and exhibits excellent external light extraction efficiency.

The present light emitting device is formed as follows. The laminated structure 11 is formed by laminating a lower cladding layer 102 made of AlGaInP mixed crystal, a light emitting layer 103 made of undoped AlGaInP, an upper cladding layer 104 made of Se-doped AlGaInP, and a conductor layer 105 made of undoped BAsP, wherein the conductor layer 105 has a bandgap of 4.3 eV. The light permeable substrate 106 is joined onto the conductor layer 105 for supporting the laminated structure 11.

The features of the present light emitting device include (a) a light permeable substrate, that is, a base plate which is transparent with respect to emission wavelength, (b) a conductor layer 105 made of a III-V group compound semiconductor containing boron, (c) a conductor layer disposed between the upper cladding layer 104 and the light permeable substrate 106, and (d) a conductor having a bandgap of 4.3 eV.

(2) Lin et al. (U.S. Pub. Application No. 2003/0047737 A1)

Lin et al. discloses a light emitting diode which includes a transparent substrate connected to an epitaxial layer via a transparent adhesive layer. A light emitting portion is formed by laminating a lower cladding layer 22, a light emitting layer 20, an upper cladding layer 18, and an epitaxial layer 16. A transparent substrate 10 is adhered on the epitaxial layer 16 via the adhesive layer. Thus, Lin's light emitting device differs from the light emitting device of the present invention in that Lin's device does not have a conductor layer 105 containing boron as required by the present claims.

(3) Udagawa et al. (U.S. Pub. Application No. 2004/0169184 A1)

Udagawa et al. discloses a boron phosphide-based light emitting device. However, Udagawa's light emitting device is a light emitting device formed by laminating on an Si substrate. Accordingly, since the Udagawa's light emitting device does not have a light permeable substrate, its structure differs from that of the present invention (and also that of Lin et al.).

The Examiner asserts that, since layer 106 of the Udagawa's device is a III-V compound semiconductor containing boron, Udagawa discloses the conductor layer 105 of the present invention. However, layer 106 of Udagawa's device is the upper cladding layer. The conductor layer 105 of the present application is formed on the upper cladding layer 104 for joining the laminated structure 11 with the light permeable substrate.

The device of the present invention is joined with a light permeable substrate. Although Udagawa et al. mentions the use of a transparent substrate made of GaN in [0046], this transparent substrate is a substrate for forming a laminated structure thereon, and is used as a seed crystal for crystal growth.

More particularly, the Examiner substitutes an upper cladding layer 106 of Udagawa et al, from a device in which the substrate is not transparent, for the lower cladding layer 18 of Lin et al. There is no apparent reason which would lead one of ordinary skill in the art to make such a substitution, especially from a technical standpoint. Further, the cited references do not disclose or suggest the above-noted features of the present invention. For the above reasons, it is respectfully submitted that the present claims are patentable over Lin et al in view of Udagawa et al, and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Notwithstanding the foregoing, and although Applicants believe that the present claims are patentable over the cited prior art, Applicants perfect and rely on their April 6, 2004 filing date of Provisional Appln. No. 60/559,429 upon which benefit is claimed, to thereby antedate the September 2, 2004 publication date of U.S. 2004/0169184 A1 to Udagawa et al. Support for the present claims is found, for example, in paragraphs [0010] to [0021] at pages 6-9 of the verified English translation of Provisional Appln. No. 60/559,429. The verified English translation of Provisional Appln. No. 60/559,429 was filed on March 31, 2005 in the provisional application. A copy of the verified English translation of the provisional application is also submitted herewith.

Additionally, the undersigned states that present application and U.S. 2004/0169184 A1 to Udagawa were, at the time the invention was made, owned by, or subject to an obligation of assignment to, the same person so as to disqualify U.S. 2004/0169184 A1 for use in an obviousness rejection under 35 U.S.C. § 102(e)/103(a) pursuant to 35 U.S.C. §103(c).

As recognized in the Office Action, Lin et al does not disclose each of the limitations of claims 1-8. U.S. 2004/0169184 A1 to Udagawa et al, relied upon by the Examiner as making up

for the deficiencies of Lin et al, has been antedated and disqualified as prior art for use in an obviousness rejection, to thereby obviate the foregoing rejection.

Withdrawal of all rejections, rejoinder of method claims 9-11 and allowance of claims 1-11 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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